

QUALITY AND SAFETY OF MARKET Vs HOME MADE CARROT HALWA: DESIGNING A SAFE PROCESS

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ABSTRACT

Carrot halwa is a popular North Indian seasonal sweetmeat. It is a perishable product due to the use of milk or its product, khoa which is very susceptible to contamination. Besides this, the method of preparation of carrot halwa further alleviates the chances of contamination i.e. poor personal hygiene of the food handlers and contaminated water which is used in the preparation of halwa. In the present study, 10 households and 7 shops from Pantnagar were selected and an interview as well as observation schedule was devised to gather information about shop owners and households, practices followed by shop owners for food handling, serving, cleaning, and maintenance of the unit and environmental hygiene of the shops. It also included information, specific to the product preparation, procurement and storage practices of ingredients as well recipe of preparing the product. One shop was selected to procure sample i.e. carrot halwa and its raw ingredients. The stepwise process of preparing carrot halwa in the same shop was also observed. After this, the sample carrot halwa was bought from the selected shop for three consecutive days, and thereafter brought to laboratory for microbial analysis viz. total plate count, total coliform count, yeast and mold count using nutrient agar, violet red bile agar and potato dextrose agar, respectively as well as quality of the water used in the preparation of halwa was determined by MPN technique.

After the microbial analysis, carrot halwa was prepared in the laboratory by the procedure followed in households as well as by that followed in market. They were then compared through sensory evaluation using score card method and hedonic scale. Thereafter, they were subjected to microbial analysis, and finally microbial load of market made and homemade carrot halwa was compared. Various Critical Control Points (CCPs) were identified in the whole process of preparation of carrot halwa and corrective measures were suggested to reduce the high microbial load in it and to make it safe for consumption. The CCPs identified in the process of carrot halwa preparation were: storage practices of ingredients, washing and peeling of carrots, contamination from the food handler, cooking and serving of the product, storage of the cooked product

The study revealed that the carrot halwa sold in the market is of poor quality with reference to the microbial count. The general facilities related to the safety and cleanliness is not available in the shops. The knowledge of shop owners and food handlers about food safety and personal hygiene is poor. Therefore, there is a need to educate and train them to ensure complete protection of carrot halwa from microbial contamination.

KEYWORDS: Carrot, Food Hygiene, Safety & CCPs

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INTRODUCTION

Carrot *halwa* is a delicious item of Indian sweet meat industry and highly relished in Northern and Western parts of India. It is a source of concentrated nutrients and calories. Carrot *halwa* is a sweet prepared by cooking shredded carrot in milk with sugar and moderately frying in hydrogenated oil with grated *khoa*. It is prepared in

commercial scale only in winter season and that too when carrots are available in plenty and cheap.

There are several studies which have implicated milk or *khoa* based sweet meats, as the vehicle responsible for food borne disease outbreaks. It is not uncommon to observe that sweetmeats are either prepared unhygienically or stored under poor atmospheric conditions giving vast scope for heavy contamination by way of dust settling down on them and rodents/ insects coming into contact with them. This would result in establishment of spoilage type microorganisms as well as pathogenic organism. This would have an adverse effect on consumers.

Hence, there is need to ensure microbial safety in sweetmeats, because of poor standards of hygiene and sanitation in street food service units, which may be a cause of unsafe carrot *halwa* production in such units. Our efforts in present study are directed towards suggesting corrective measures for ensuring microbial safety to street vended carrot *halwa* with the specific objectives to study the ingredients and process variables from different shops/ mobile units and homes for preparing carrot *halwa*; compare the microbiological counts of homemade and market made carrot *halwa*; determine acceptability and ascertain shelf life of market made and homemade carrot *halwa* and finally outline safer and hygienic process of preparation of carrot *halwa*.

MATERIALS AND METHODS

Sample and Locale of the Study

Shops of Pantnagar market and local residents of Pantnagar, who volunteered to participate in the study, were included in the sample. In all, ten households and seven shop owners were included in the study.

Tools

Interview schedule, specially designed for gathering information about shop owners and households' practices, followed by shop owners for food handling, serving, cleaning and maintenance of the unit and environmental hygiene of the shops were included as information specific to the product preparation, procurement and storage practices of ingredients as well as the recipe of preparing the product.

A sensory evaluation proforma was developed using scorecard method and nine point hedonic scale (Amerine *et al.*, 1965) for comparing the acceptability of market made carrot *halwa* with that of home-made carrot *halwa*.

Microbial Analysis

Seven shops and ten households were interviewed on the above mentioned attributes. Thereafter, sample (cooked product, ingredients- raw carrot, milk/ *khoa*) was collected from a selected shop, who volunteered to give samples on three consecutive days. The collected samples were then analysed for total plate count, coliform count and yeast and mold count by the procedure of Busta *et al.* (1976). The plate count method is generally accepted as a satisfactory method for estimating the total number of viable bacteria in foods (ISI, 1969). Microbiological quality of water samples was determined by the most probable number (MPN) technique as given by Oblinger and Koburger (1976). Water was used in preparation of carrot *halwa* chosen for the study.

Analysis of Data

The data gathered with the help of interview schedule were analyzed by calculating % age, which was calculated by multiplying the frequency of particular item by 100 and dividing it by total frequency of item. The data obtained from sensory evaluation were analysed by calculating the mean values.

RESULTS AND DISCUSSIONS

General Profile of Street Food Vendors

The general profile of the street food vendors (SFVs) selling carrot *halwa* in Pantnagar was studied. All vendors were males. A large proportion of them (42.85%) were in the age group of 18-34 years and above 50 years. Rests of them (14.28%) were in the age group of 35-50 years. About 57.14% of the vendors were educated up to secondary level while rests of the vendors (42.85%) were educated only up to primary level. Hence, by looking at this finding, it can be concluded that low level education of vendors is predominant in this business. Chakravarty and Canet (1996) reported in Kolkata, most of vendors had primary level education and 21% were illiterate. Bharathi (1995) reported that in Hyderabad 46% were illiterate, 36% had secondary school education, while 18% had primary school education. In Pune almost 75.4% of the street food vendors did not complete their primary school. Only 22.2% had completed secondary school education, while 2.2% were university graduates (FAO, 1986). About 71.42% of the vendors had shops as their main occupation, while rest of them (28.57%) were mobile street food vendors selling carrot *halwa* in the weekly market (*haat*), who also had sweet meat shops as their main business.

Information about the Shops

Physical Facilities At units

Information about the shops and mobile units selling carrot *halwa* was collected. All the equipments, utensils either cooking or serving were found to be dirty, uncovered and stored at filthy places at all the shops. Washed serving utensils were kept as such on the racks inside the shops indicating that there was no separate area for storing them. All this indicated the poor storage practices followed by the vendors for storage of utensils and equipments.

At majority of the street food units (79%), knives were made up of iron, while at rest of the units (21%) stainless steel knives were used. Chopping boards were made up of wood, *karahies* for cooking were made up of iron, spoons and forks for serving were made up of stainless steel at all the shops. Ladles made up of aluminium and serving plates made up of stainless steel were used at most of the shops (55 and 68%, respectively), whereas, stainless steel ladles and serving plates of melamine were used at rest of the units (45 and 32%, respectively). Tumblers for serving water to the customers were used at most of the shops (70%), whereas, rests of them (30%) were using reused plastic bottles. Out of the 70% of the vending units serving water in tumblers, more number of units (57%) was using stainless steel tumblers whereas at rest of the units (43%) they were made up of glass. All this indicated that disposables were not used for serving water or food.

Water Facilities and Storage Practices of Water

Information regarding water facilities was sought and a greater number of the shops had tap water facility (43%), followed by 29% of the shops which use stored water while rest of the units (28%) use hand pump. Out of units using stored water, most of them use tap water as the source (71%) while rest of the units (29%) use hand pump as the source of stored water. These findings are in line with the findings of FAO (1992) in Kathmandu Nepal and Bryan *et al.* (1992) in Pakistan, but are contrary to the findings in China where municipal tap water facilities were nonexistent (FAO, 1993). The storage of water was done in plastic containers at most of the units (71%), while rests of them (29%) were using plastic and stainless steel containers both. Appearance of the containers used for storage of drinking water was found to be covered but dirty at most of the units (80 and 60%, respectively). Containers used for storage of water used in washing vegetables were

found to be dirty and uncovered in most of the units (60% each). Whereas, containers meant for the storage of water used for washing utensils were found to be covered but dirty in majority of the units (57.14% each).

Sanitary Practices Followed by the Shop Owners

The practices followed for cleaning of shops as reported by shop owners were documented and it was evident that at most of the units (62.5%) cleaning was done only once in morning, before starting their work while rest of them (37.5%) cleaned 2 to 3 times daily.

At most of the units (79%) cleaning was done with cloth only, while rest of the units (21%) used water only. No one used detergent and any sanitizer for cleaning the stall. Although the units used separate cloth for cleaning the stall but they were dirty. All of them reported that they used water and soap cakes or detergent powder for cleaning the wiping cloths but the dirty appearance of the wiping cloths was defying their response.

All the vendors reported daily cleaning of the surrounding areas of shops; however, a messy picture in the study revealed poor sanitation and hygiene of surrounding area of units. Studies done by Chandrasekhar *et al.* (2003) and Bryan *et al.* (1988) revealed the similar findings regarding hygiene and sanitation of surrounding area of vending units.

Observations on the Shops and Mobile Street Food Unit Selling Carrot *Halwa* in Pantnagar

The average of positive observations regarding management of the unit, food preparation and handling, cleaning practices and personal hygiene was estimated.

Management of the Unit

It can be concluded by the observation that most of the units had poor management. There was no such unit which had exhaust fan and chimney in the kitchen and neat wash basins along with other sanitary facilities. Less than half of the units were free of garbage, insects and flies. Average of positive observations for all the carrot *halwa* vending units was only 1.42 out of 10.

Food Preparation and Food Handling Practices

Observation regarding the food preparation and handling practices revealed that very few shop owners use stainless steel knives, cleaning and chopping boards for vegetables. Neither of the shop owners practiced covering the food items before and after cooking nor the serving vessels were covered and kept at neat and dry place at any of the shop. Carrots were not washed properly i.e. before and after peeling them at any shop. Most of the vendors washed the carrots only before peeling (71%). While rest of them washed carrots only after peeling (29%). Hence, regarding the practices related to preparation of carrot *halwa* about 3.85 out of 8 points were positive which suggested that it was not prepared under proper hygienic conditions.

Cleaning Practices

It was observed that in most of the shops (70%), utensils were washed immediately after use, but cleaning and washing was not done away from the kitchen in any of the unit. Although majority vendors (60%) used synthetic scrubbers for washing utensils, but all of them didn't practice final cleaning of utensils in running water. Utensils and equipments were kept uncovered and were found to be dirty in all the units. Three tub system of dish washing (one for initial dip and wash, second and third for rinsing and cleaning) was not used by anyone. They were either using two tub system or a

single tub for dish washing. Washed serving utensils were stored at filthy places at all vending units. Utensils were wiped before use with separate but dirty napkins which were stored at unclean places. All the vendors used detergent powder for dishwashing. These observations clearly show the ignorance of vendors towards the cleaning and sanitary practices. This fact is supported by the studies done by Cox (1938) and Krog and Dougherty (1936) which discussed about the continued widespread ignorance concerning proper and effective methods of sanitizing dishes and glassware. Besides this, most foodservice personnel felt that dishwashing was satisfactory as long as the dish appeared reasonably free of visible soil and few complaints were made by the clientele (Kupchik and Katz, 1977). The average of positive observations regarding cleaning practices was found to be 3 out of 5 points.

Personal Hygiene

The average of positive observations was 3.14 out of 10 points, which indicated that the personal hygiene of the food handlers was not up to the mark. Washing of hands with soap was not observed before and after food preparation. Nails were found trimmed but dirty of 50% vendors whereas dresses of majority of the vendors were dirty. None of the vendors was using apron, head gears or disposable gloves. It was also found that most of the vendors did not have separate napkins for wiping hands. This indicated that they might be using same napkins for wiping utensils which were used for wiping the hands. Similarly, separate napkin or towel for wiping sweat or nose was not found even with a single vendor. The napkins used for wiping hands were found to be dirty and kept at mucky places. The improper personal hygiene of the vendors indicated that the food handled by them was at high risk of contamination.

The Process Flow of Carrot Halwa Preparation- Home and Market Method

Ingredients used by the Shops and Households

By the survey conducted on seven shops and ten households, it was evident that all the shops use basic ingredients i.e. carrots, *khoa*, sugar, hydrogenated oil. There were slight variations in the use of grated coconut, cardamom, raisins, cashew nuts and almonds.

The major difference observed in the use of ingredients between shops and households was the use of milk by all the households instead of *khoa*. Besides this, almost all the housewives use ghee as a replacement for hydrogenated oil.

Procurement and Storage Practices of Ingredients

The ingredients; milk, sugar, hydrogenated oil and dry fruits were purchased from the groceries by all the shopkeepers, while *khoa* was procured from either Rudrapur or Bareilly market by all of them. The frequency of purchase of milk and *khoa* was daily while that of other ingredients was twice a month. It was found that all the ingredients were stored at room temperature at every shop. Carrots were purchased from *haat* twice a week and were stored at room temperature. The hydrogenated oil used by the shopkeepers was not kept in airtight containers instead; it was kept uncovered at room temperature.

Regarding the households, all the ingredients except carrots and milk were purchased twice or thrice a month and were stored at room temperature. Carrots were procured once a week by half of the housewives and once a fortnight by rest of them. Milk was purchased daily by all of them. Carrots and milk were stored in the refrigerator at all the households.

Process of Preparation- Carrot Halwa

The quantity of raw material used in one time preparation by all the shops was found to be 10-15 kg carrot, 2-5 kg

khoa, 2-5 kg sugar and less than 2 kg hydrogenated oil. None of the shopkeepers reported washing of carrots before as well as after peeling. Most of them (71%) washed carrots only before peeling them whereas rest of the shopkeepers (29%) washed the carrots only after peeling.

The washing of carrots was done by stored water by all the shopkeepers. The source of stored water used for washing of carrots was municipal tap water. Storage containers were found to be dirty and uncovered in majority of the shops (60%).

It was observed that the washed and peeled carrots were stored at room temperature in open plastic containers which appeared dirty.

The total quantity prepared by all the shopkeepers was between 8-10 kg. As they reported, the frequency of preparation of carrot *halwa* was found to be once in 2 or 3 days depending upon the sale by all the shopkeepers. The amount of carrot *halwa* sold in a day was 6-7 kg as reported by the shopkeepers. Hence it is evident by this fact that there was left over for next 1-2 day(s) again depending upon the sale. This left over was stored at room temperature by all the shopkeepers in a covered vessel. On the other hand, quantity of carrots used at all the households was between 1-3kg. Same quantity of milk (equivalent to carrots) was used with 300-500g of sugar and 20-30g of *ghee*.

Half of the housewives reported to wash the carrots before and after peeling, whereas, rest of them washed the carrots only after peeling. Majority of the housewives (90%) used milk only after boiling it, while rest of them (10%) boiled milk along with the carrots. In most of the households (70%), the frequency of preparation of carrot *halwa* was once a fortnight, while at rest of the households it was prepared more frequently i.e. once a week. All the housewives reported that there was leftover (3-5 bowls) which lasted for maximum three days. Majority of them (70%) stored the left over in refrigerator whereas rest of them (30%) stored it in room temperature inside covered containers.

Microbiological Quality of Carrot *Halwa* Sold in the Market and Its Ingredients

Microbial analysis of carrot *halwa* and its ingredients viz. grated carrot, milk was done (Table 1 to 3).

The TPC of raw carrot was analysed in three ways i.e. by washing and peeling it, peeling and not washing, neither peeling nor washing. The TPC and TCC were found significantly higher in case of neither peeling nor washing the carrot than the other two. TPC and TCC were again higher than standards [Standard limit- $<10^5$ cfu/g for miscellaneous foods] [Abrahamson (1959), Fitzgerald (1937), Hobbs (1959), Thatcher (1963)] in case of only peeling and not washing the carrots. On the other hand they were within the standard limits in case of washing and peeling the carrots. The YMC was not detected in any of the three cases. The high TPCs and TCCs of carrot were indicative of poor hygiene and sanitation in handling.

The TPC and YMC of milk in raw form collected from the shop were higher than the limits whereas coliforms were not detected. As reported by Jay (1997) yeasts and molds are active at low pH and can even grow under refrigeration temperature.

The microbial quality of carrot *halwa* bought from the sample shop on three different days within three weeks was tested. The microbial quality was tested again after two days storage inside the refrigerator. The TPC and YMC were found significantly higher even on the first day of procurement when the product was prepared. After two days storage, the TPC was too much high i.e. the number of colonies was greater than 300. Coliform was also detected from the sample. It is

evident by this result that the microbial quality of carrot *halwa* sold in the shop is not apposite. Further, its quality is degraded so much after two days storage that its consumption can pose serious health hazard. Despite of this fact, it was revealed by the survey that the *halwa* is left for 2-3 days, which is then mixed with the freshly prepared product and sold as such, thus contaminating even the freshly cooked product.

Comparison of the Microbiological Quality of Carrot *Halwa* Prepared in Laboratory by Market and Home Method

Carrot *halwa* prepared in the laboratory following both the market and home procedure was tested for microbial quality (Table 4). The results of microbial tests revealed that the TPC on first day i.e. the day when product was cooked by home method; was within the standard limits. Besides this, no significant increase in TPC was seen even after two days storage when *halwa* was cooked by home method. Neither coliform nor yeast and mold were detected in the product. The inhibition of the growth of yeast and mold may be attributed to the action of isocoumarine, which is naturally present in traces in carrot (Hohn and Kunsh, 2003).

On the other hand, TPC was found above the standard limit when *halwa* was cooked by market method. The number of colonies increased beyond 300 after two days storage. Coliform were also detected in the product. Yeast and mold count was found to be significant which increased after two days storage. By this finding, it may be concluded that the growth of yeast and mold in carrot *halwa* prepared by market method might be due to the use of raw *khoa*, which is contaminated.

Hence, by the microbial results, it is evident that there is significant difference in the microbial quality of carrot *halwa* sold in the market and *halwa* prepared in the laboratory by both the methods. The factors such as washing of carrots with contaminated water, handling of the ingredients with contaminated hands and knife, storage in dirty and uncovered containers or open and unclean places might be attributed to high microbial load in the product. Besides this, a major factor responsible for the high microbial load of carrot *halwa* sold in the market and that prepared in the laboratory by market method might be the use of *khoa* which is improperly handled and thus contaminated by the food handlers. Moreover, the shop keepers use some part of uncooked *khoa* for final decoration of the product before serving or selling. This practice makes the product highly susceptible to microbial contamination. Besides this, long hours of storage of cooked product at room temperature may also contribute to increase in microbial count further. Although milk and milk products provide a wealth of nutritional benefits. But raw milk can harbour dangerous microorganisms that can pose serious health risks.

Sanitary Quality of Water

Sanitary quality of water used in washing carrots and utensils is presented in terms of MPN of coliforms (Table 5). It is evident from the results that water samples had higher MPN of coliforms (1700 MPN/100 ml) than the standard i.e. 10 MPN/100 ml (Vanchianathan, 1992). *E. coli* was found to be present indicating faecal contamination of dishwashing water. High MPN of coliforms may be attributed to the practice which is followed by the vendors i.e. utensils were kept in containers having water and left over of food which had not been scrapped from utensils before putting them in dish washing water. Thus, high MPN of coliforms and presence of *E. coli* in dish washing water indicates its poor sanitary quality.

Microbial analysis of water used in washing carrots showed higher MPN of coliforms (93/100) than the standard. It might be attributed to poor practices followed for storage of water such as storage in dirty and uncovered containers. Similar findings regarding sanitary quality of water used by street food vendors were reported by Chakravarthy (1994) in

Calcutta. The findings of this study are also in line with the study conducted by Chandrasekhar *et al.* (2003) in Kerala wherein water samples used for drinking and cooking purposes by vendors were found to be of poor microbiological quality (860 MPN/100 ml).

Safer and Hygienic Process of Preparation of Carrothalwa

It is evident from the observation and microbial results that the process of preparation of carrot *halwa* is not safe and hygienic. Such unhygienic practices make the product unsafe for consumption. Certain Critical Control points (CCPs) identified during the process of preparation of carrot *halwa* by market method was: storage practices of ingredients, washing and peeling of carrots, storage of cooked product (Figure 1).

Sensory Quality Attributes of Carrot Halwa Prepared by Home and Market Method

The carrot *halwa* prepared by both the methods was tested by a panel of ten members through score card method (Table 6) and nine point hedonic scale (Table 7) for comparing the acceptability between the two. The results showed that average of the sensory scores of carrot *halwa* prepared by home procedure was accepted over the market procedure. Sensory evaluation was again done after two days storage and by the results; it was evident that the quality of *halwa* prepared by market procedure was degraded largely by all the attributes chiefly in taste and flavour. This may be due to the use of *khoa* (raw form) in the *halwa* which contaminates the product and develops off flavour.

Safer and Hygienic Alternative of Preparation of Carrot Halwa

By looking at the microbial results of market made *halwa*, a safer and quicker method was devised (by using condensed milk) and the *halwa* was prepared in the laboratory by that method (Figure 2). It was seen that when the product was cooked by that method, it took lesser time i.e. half of the original time; hence it can be used at households as well as commercial level to save time and fuel. Moreover, the TPC of carrot *halwa* was also found to be within acceptable limits (1.65×10^2 cfu/g). Pressure cooking the grated carrots followed by the use of condensed, pasteurized milk may be possible for the low TPC of carrot *halwa*.

REFERENCES

1. Abrahmson, A.E.; Buchbinder, L.; Guentel, J. and Heller, M. 1959. A study of frozen precooked foods. Their sanitary quality and microbial standard for control. *Assoc. Food Drug Official.* 23: 63-72.
2. Amerine, M. A.; Pangborn, R. N. and Roseller, E. B. 1965. *Principles of Sensory Evaluation of Food.* New York, Academic Press. 334-354.
3. Bharathi, S. 1995. *Consumption of street foods by urban population and their safety.* Thesis, M.Sc. Andhra Pradesh Agricultural University, Andhra Pradesh.
4. Bryan, F. L.; Michanie, S. C.; Vizcarra, M. M.; Navarros, O.; Taboada, D.; Fernandez, N. M.; Regarejo, C. E. and Manoz, P. B. 1988. Hazard analysis of foods prepared by inhabitants near lake Titicaca in Persurian Sceirca. *J. of Food Protection.* 51(5): 412.
5. Bryan, F.L.; Teufel, P.; Riaz, S.; Roohi, S.; Quadar, F. and Malik, Z. 1992. Hazards and critical control points to street vending operations in a mountain resort town in Pakistan. *J. Food Protection.* 55(9): 701-707.
6. Busta, F. F.; Peterson, E. H.; Adams, D. M. and Johnson, M. G. 1976. Colony count methods. In: Speck, M. L. ed. *Compendium of Methods for Microbiological Examination of Food.* New York, American Public Health Association. 63-83.

7. Chakravorthy, I. 1994. Urban street foods in Calcutta, Abstracts of scientific sessions of 27th annual meeting of The Nutrition Society of India. Hyderabad, National Institute of Nutrition. p6.
8. Chakravorthy, I. and Canet, C. 1996. Street foods in Calcutta. *Food Nutr. Agric.* 17/18: 30-37.
9. Chandrasekhar, U.; Kowsalya, S. and Ladha, P. 2003. Proximate composition, microbial and chemical contamination of street vended foods versus home-made and restaurant foods from Kochi, Kerela. *J. of Food Science and Technology*. 40(1): 58-62.
10. Cox, W. C. 1938. Use of dishwashing machines: Pasteurization of eating utensils. *Am. J. Public Health*. 28: 174-180.
11. Fitzgerald, G.A. and Conway, W.S. 1937. Sanitation and quality control in the fishing industries. *Am. J. Public Hlth*. 26: 1094.
12. Food and Agriculture Organization (FAO). 1986. Study on street foods in Pune, India. Pune, FAO and State public health laboratory Pune. 1-33.
13. Food and Agriculture Organization (FAO). 1992. Street foods in Asia. Kuala Lumpur, Malaysia, FAO. 1-30.
14. Food and Agriculture organization (FAO). 1993. A pilot study on improving the safety of urban streets in China. Beijing, FAO and Ministry of Public Health.
15. Hobbs, B.C. 1959. Sampling and examination of faeces from food handlers for salmonellae, shigellae, enterpathogenic E.coli and C. perfringens. *Appl. Microbiol.* 14: 928-933.
16. Hohn, E. and Kunsh, U. 2003. Carrot flavour- acceptance, sweetness and bitterness. *Agrarforschung*. 10: 144-149.
17. Indian Standard Institute (ISI). 1969. Method for plate count of bacteria in foodstuffs (IS: 5402). ISI. 4-13.
18. Jay, J. M. 1997. Modern Food Microbiology. 5th ed. New York, Chapman and Hall. p661.
19. Krog, A.J. and Dougherty, D.D. 1936. Effectiveness of the methods of dish and utensil washing in public eating and drinking establishments. *Amer. J. Public Health*. 26:897-900.
20. Kupchik, G. J. and Katz, J. 1977. Potential health hazards associated with reusable foodservice utensils. *J. of Food Prot.* 40: 132-134.
21. Oblinger, J. L. and Koburger, J. A. 1976. Most probable number technique. In: Speck, M. L. ed. *Compendium of Methods for Microbiological Examination of Food*. New York, American Public Health Association. 99-111.
22. Thatcher, F.S. 1963. The microbiology of specific frozen foods in relation to public health. *J. Appl. Bacteriol.* 26: 266-285.
23. Vanchianathan, S. 1992. Laboratory support services in food safety: Microbial contaminants- current status and regulations. In: proceedings of national workshop on food safety in public catering, Hyderabad, November 1-3, 1989. Food safety in public catering: Proceedings. Bhat, R. V.; Rao, R. N. eds. Hyderabad, National Institute of Nutrition. 104-118.

APPENDICES

Table 1: Microbial Count of Raw Carrots (cfu/g)

	Neither Peeled Nor Washed	Peeled Not Washed	Peeled and Washed
TPC	7.9×10^6	1.07×10^6	8.2×10^4
TCC	8.1×10^5	3.4×10^4	3.4×10^2
YMC	<30	<30	<30

Table 2: Microbial Count of Milk (cfu/g)

TPC	2.74×10^5
TCC	-
YMC	4.8×10^3

Table 3: Microbial Count of Carrot *Halwa* Bought from Market (cfu/g)

	Day I	Day II
TPC	1.95×10^6	1.9×10^9
TCC	5.4×10^3	5.4×10^3
YMC	6.57×10^4	8.3×10^4

Table 4: Microbial Count of Carrot *Halwa* Prepared in Lab (cfu/g)

	Home Made Method		Market Made Method	
	Day I	Day II	Day I	Day II
TPC	1.89×10^3	2.04×10^3	8.11×10^5	3.0×10^8
TCC	ND	ND	4.1×10^2	8.7×10^2
YMC	ND	ND	3.7×10^2	1.02×10^3

Table 5: Microbial Analysis of Water

Type of water	Reading	MPN/100 ml	<i>E. coli</i>
Water for washing utensils	3:3:3	≥ 1700	Positive
Water for washing carrots	3:3:0	93	Negative

Table 6: Average of Sensory Quality Attributes of Home and Market Made *Halwa*

Attributes	Day I		CD at 5%	Day II		CD at 5%
	Home	Market		Home	Market	
Colour	8.85	7.55	0.342	8.25	6.9	0.342
Appearance	9.15	7.6	0.399	8.35	6.8	0.399
Flavour	8.35	6.6	0.360	8.4	6.35	0.360
Taste	9	6.4	0.384	8.25	5.6	0.384
Texture	8.85	6.75	0.442	8.2	5.4	0.442
Overall acceptability	8.65	6.95	0.395	7.85	5.1	0.395

Table 7: Average of Hedonic Scores of Home and Market Made *Halwa*

	Day I		CD at 5%	Day II		CD at 5%
	Home	Market		Home	Market	
Hedonic scale score	8.8	6.75	0.383	7.8	5.65	0.383

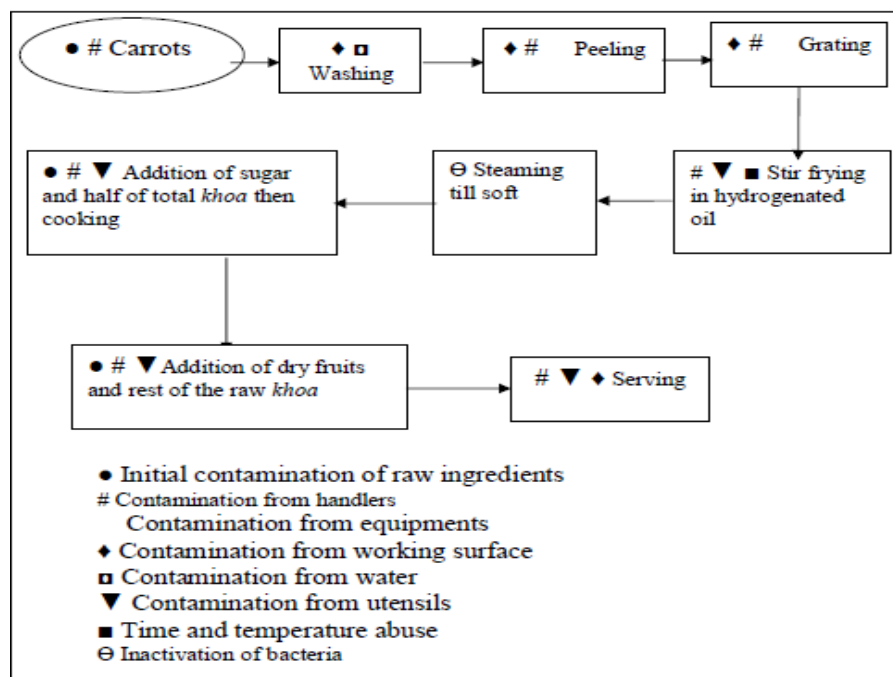


Figure 1: Preparation Flow Chart for Carrot *Halwa*- Market Method; Indicating Critical Control Points for Food Hygiene

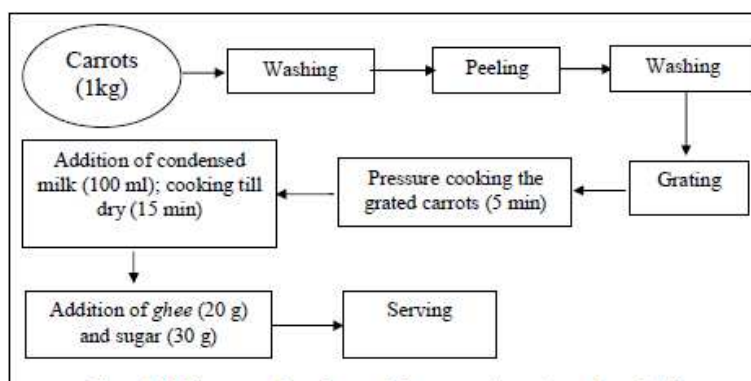


Figure 2: The Process Flow of Carrot *Halwa* Preparation using Condensed Milk

